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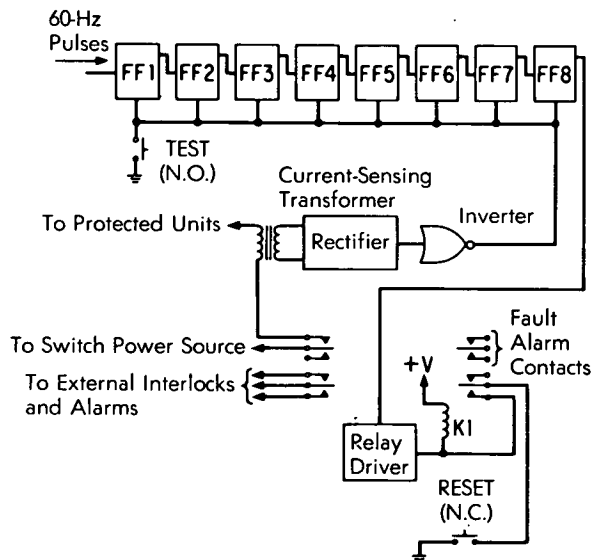
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Waveguide Switch Protector

Waveguide switches are often driven by a gear-reduced DC motor. No power is supplied to the motor when the waveguide switch arm is in its desired position; however, if the switch arm becomes immobilized by accidental jamming of the mechanism, the motor will be destroyed when power is applied. Waveguide-switch failures are of two general types: (1) The waveguide arm is locked between positions, and the limit switches cannot be activated to turn off the motor. (2) A limit switch has failed, allowing the motor to continue to operate even though the waveguide switch arm has reached a mechanical stop. Of course, fuses are usually installed in the motor power lines, but since they are expected to protect several waveguide switches, an individual motor cannot be reliably protected.

The key to protection of a waveguide-switch motor is to sense when the motor has been operating for an excessive amount of time. The protection unit shown in the diagram converts 60-Hz line voltage to timing pulses by means of an "exclusive or" circuit that utilizes a dual two-input gate. The timing pulses are applied to a divide-by-256 circuit (FF1 to FF8). During the period when the waveguide switch is not being operated, the reset line of FF1-FF8 is at approximately +3.6 volts and the flip-flops are prevented from counting. When the waveguide switch motor is activated, a sharp increase in voltage occurs at the output of the current-sensing transformer; the transformer output is rectified and inverted, forcing the flip-flop reset lines to a low potential and thereby enabling the counter chain to count 60-Hz pulses. If the waveguide switch completes its cycles and the motor

stops before FF8 is set (approximately two seconds), the output of the inverter is returned to a high potential (+3.6 volts); thus, all flip-flops are set and the count is stopped. The circuit is once again at the starting point.



If the waveguide switch does not stop drawing current before FF8 is set, motion of the switch arm has been blocked; in this instance, when FF8 is set, relay K1 is closed, an external alarm is given to the operator, and simultaneously power is removed from the waveguide switch by a slave relay. One set of contacts on K1 are used to hold K1 closed until the circuit is reset manually; this prevents the circuit from recycling and setting up an oscillation which would eventually lead to destruction of the switch motor.

(continued overleaf)

A TEST function is provided so that the operator can assure himself that the protective circuit is operating properly; for the test, a normally-open push button is held closed for the two seconds or so required to set FF8 and activate the alarm. Momentary operation of the RESET push button returns the circuit to normal operation.

The time required to activate relay K1 can be changed by modifying the counter chain, or the repetition rate of the pulse generator, or both. By proper selection of the current-sensing transformer and inverter circuit constants, a number of waveguide switches can be protected by this circuit.

Notes:

1. This circuit may be used in many other applications, particularly where positive protection of expensive critical components is required. Such applications include machine tool positioners, spacecraft antenna positioners, servomechanisms, and intermittent drives using high-power series-wound motors which are designed for high starting torque

but not for continuous operation beyond a designated time interval.

2. Because it is digital in operation, this unit is not sensitive to variations in temperature and voltage. Also, it can be made very small and light, as well as low in cost.
3. Requests for further information may be directed to:

Technology Utilization Officer
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4800 Oak Grove Drive
Pasadena, California 91103
Reference: TSP 72-10705

Patent status:

NASA has decided not to apply for a patent.

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